SECTION A. TECHNICAL NOTES

SCOPE

This report presents data on the demographic and employment characteristics of Federal scientists and engineers. This population consists of individuals in selected white-collar civilian occupational groups who hold at least a university or college bachelor's degree. One table also provides information on Federal civilian white-collar personnel educated in S&E fields but employed in non-S&E occupations. This report continues the format of a historical 5-year time series. The statistical tables were prepared by selecting various crosscuts of the following data elements on Federal scientists and engineers:

1. Agency of employment
2. Primary work activity (functional classification)
3. Sex
4. Occupational group and series
5. Highest degree field
6. Race/ethnicity
7. Geographic division and state of official duty station
8. Age
9. Highest degree level

DATA SOURCES

The Office of Personnel Management (OPM) collected and extracted the data from their Central Personnel Data File (CPDF) and provided them to the National Science Foundation. The CPDF, established in 1972 and maintained by OPM, is an automated system of individual records for almost all Federal civilian employees. Agencies collect these data on their employees from requests and notifications of individual personnel actions. The CPDF is maintained by monthly agency input of employment status files. All input files are edited for validity. The CPDF contains almost 2 million records on full-time nonpostal Federal civilian employment. The effective date of data provided for 1998-2002 is December 31 of each year.

AGENCY COVERAGE

The CPDF does not contain information for (and as a result the report excludes data for) the following Federal civilian employees: Members and employees of Congress, Architect of the Capitol, Botanic Gardens, Library of Congress, General Accounting Office, Congressional Budget Office, John C. Stennis Center for Public Service Training and Development, Office of Compliance, U.S. Court of Appeals to Veterans Claims, Commission on Security and Cooperation in Europe (data not provided for 1998), Judicial Branch, White House Office, Office of the Vice President, Office of Policy Development, Board of Governors of the Federal Reserve System, Panama Canal Commission, Central Intelligence Agency, National Security Agency, National Imagery and Mapping Agency, Army/Air Force Exchange Service, Defense Consolidated Metropolitan Technical Personnel Center, Defense Career Management and Support Agency (data not provided for 1998), U.S. Postal Service, Postal Rate Commission, and foreign nationals employed overseas. The Tennessee Valley Authority (TVA) does not report to the CPDF, but the CD-ROM provided to the National Science Foundation by OPM was supplemented to include TVA data. However, due to the unavailability of data for certain years, TVA data were not included in the report.

OCCUPATIONAL COVERAGE

The data reported in this report should be used with caution when examining data reported on Federal scientists and engineers in previous years. Some reports published prior to this report contain data about all scientists and engineers, regardless of their highest degree level. This report covers only Federal scientists and engineers with at least bachelor's degrees.

The occupational list in Section C indicates the occupational group and OPM series, by code number, of all scientific and engineering personnel in the Federal Government. The list of occupations selected is presented together with the occupational codes established for NSF's SESTAT (Scientists and Engineers Data System). The occupational classification system NSF has established for all of its S&E personnel surveys. Section C lists the Federal science and engineering occupations selected from the CPDF and the corresponding SESTAT major and minor occupational groups.

DEFINITIONS OF WORK-ACTIVITY CLASSIFICATION CATEGORIES

These definitions are used by the Office of Personnel Management to gather information on work activities of Federal scientists and engineers:

- Clinical practice, counseling, and ancillary medical services

- Construction Data collection, processing, and analysis
- Design
- Development
- Installation, operations, and maintenance
- Management
- Natural resources operations
- Planning
- Production
- Regulatory enforcement and licensing
- Research
- Research contracts and grants administration
- Scientific and technical information
- Standards and specifications
- Teaching and training
- Technical assistance and consulting
- Testing and evaluation

Clinical practice, counseling, and ancillary medical services. The provision of direct clinical and related services to patients and clients including examining, testing, diagnosis, treatment, therapy, casework, counseling, disability evaluation, and related patient care services.

Construction. The original erection, repair, and improvement of structures that provide shelter for people and activities, support transportation systems, and control natural resources. The work involves surveillance and control of construction operations carried out in-house or under Federal grants, contracts, or loans through the following activities:

1. Conducting site surveys
2. Reviewing and interpreting project plans and specifications
3. Making cost analyses and estimates
4. Laying out and scheduling operations
5. Investigating materials, methods, and construction problems
6. Negotiating with utilities, contractors, and agencies involved
7. Inspecting work in progress and completed work and final acceptance of completed work

Data collection, processing, and analysis. The collection, processing, and analysis of general-purpose scientific data describing natural and social phenomena. General-purpose scientific data include newly gathered statistics, observations, instrument readings, measurements, specimens, and other facts obtained from such activities as statistical and field surveys, exploration, laboratory analyses, photogrammetry, and compilations of operating records for use by others. The following activities are involved:

1. Determining data needs and data processing requirements
2. Planning, directing, and evaluating collection activities performed in-house or under contract
3. Designing overall processing plans and systems to handle, control, operate, manipulate, reduce, store, check, and retrieve data
4. Analyzing raw and processed data for validity and subject-matter interpretation
5. Providing analytic services such as chemical analyses
6. Forecasting and projecting data conditions
7. Summarizing and presenting data for general use

Excluded from this category are collection and analysis of data only for R&D projects and internal operating or administrative purposes such as policy formulation or planning.

Design. The planning, synthesis, and portrayal for purposes of fabrication or construction of structures, equipment, materials, facilities, devices, and processes that will perform useful functions or be suitable for certain duties. The work involves the following activities:

1. Investigating, analyzing, and determining needs and design considerations
2. Planning, synthesizing, and proportioning the structure of mechanisms so that the result is achieved with safety and economy
3. Preparing design criteria, detailed designs, specifications, cost estimates, and operating instructions
4. Reviewing and evaluating design proposals and designs prepared by others including the management of architectural and engineering contracts. For present purposes, design in an R&D organization is the application of the known state of the art in the form of standard guidelines and references to prepare the detailed working plans and data required for fabrication, assembly, and production.

Development. Systematic application of scientific knowledge directed toward the creation of new or substantially improved equipment, materials, instrumentation, devices, systems, mathematical models, processes, techniques, and procedures that will perform useful

functions or be suitable for particular duties. The work involves the following activities:

1. Establishing requirements for technical objectives and characteristics
2. Devising and evaluating concepts for design approaches, criteria, parameters, characteristics, and interrelationships
3. Experimenting, investigating, and testing to produce new data, mathematical models, methods of testing concepts; formulating design criteria; and measuring and predicting natural and social phenomena and performance
4. Designing and developing prototypes, breadboards, and engineering models including the direction of their fabrication as required
5. Developing standards and test plans to assure reliability
6. Managing specific developments being executed in-house or under contract

Like research, development advances the state of the art, but it is further characterized by the creation of specific end-items in the form of equipment or equipment systems (hardware development) and/or methodologies, mathematical models, procedures, and techniques (software development).

Installations, operations, and maintenance. The installing, assembling, integrating, and assuring of the proper technical operation and functioning of systems, facilities, machinery, and equipment. The work involves the following activities:

1. Analyzing operating and environmental conditions in order to provide design inputs and feedbacks and modifying designs as necessary to adapt them to actual environments
2. Developing and determining logistic requirements, documentation, technical plans, procedures, controls, and instructions
3. Equipping, supplying, and commissioning facilities
4. Analyzing performance and cost data and developing actual performance and cost-data requirements
5. Integrating equipment installation and operating schedules
6. Managing onsite an operating facility such as a power plant, test range, mission control center, irrigation station, data acquisition station, or flight control station
7. Managing installation, operations, or maintenance contracts

Management. The direction and control of science and engineering (S&E) programs in any one or combination of functions in a line or staff capacity with responsibilities that have a direct and substantial effect on the organizations and programs managed. The work involves decisions, actions, and recommendations that establish the basic content and character of the programs directed in terms of program objectives and priorities, program initiation and content, funding, and allocation of organizational resources.

This category is not intended to cover those primarily engaged in the supervision or monitoring of work carried out through contracts and grants or in contracts and grants administration. Such positions are coded to the appropriate function.

Natural resources operations. The development and utilization of federally owned lands and natural resources for the purposes of bringing current use into balance with natural processes of renewal to assure sustained yields to meet present and future public needs. Natural resources include land, air, and water, and their related products or uses, such as soil, minerals, timber, forage, wildlife, power, and recreation. The work involves implementing programs and projects to inventory, classify, utilize, improve, conserve, regulate, protect, sell, lease, exchange, or market natural resources. Resource operations as defined here are concerned with managing and conserving the land and resources in specified geographic areas.

Planning. The study and projection of present and future needs and the formulation of alternative policies and ways of meeting these needs for the utilization of land; natural, social, industrial, material, and manpower resources; physical facilities; and social and economic services and programs. The work involves the following activities:

1. Gathering, compiling, analyzing, and evaluating data
2. Projecting needs and establishing goals
3. Developing single or alternative plans, policies, programs, and recommendations and measures of their economic, social, and political costs, benefits, and feasibility
4. Reevaluating progress to assure that objectives are realized in putting the plans into effect

This category includes physical, economic, and social planning for land population centers and mission, policy, and program planning.

Production. The fabrication and manufacture of structures, equipment, materials, machines, and devices. The work involves surveillance and control of production operations carried out in-house or under contract through the following activities:

1. Planning, directing, controlling, inspecting, and evaluating production processes, equipment, and facilities
2. Refining designs to adapt them to production facilities and processes
3. Devising, applying, and monitoring procedures to measure and assure quality

Regulatory enforcement and licensing. The application and enforcement of laws, rules, regulations, orders, and governmental agreements through inspection, investigation, surveillance, licensing, certification, and similar activities. The work includes activities such as the following:

1. Licensing power plants and radio stations
2. Enforcing plant or animal-disease eradication programs
3. Examining applications for patents
4. Inspecting operations for compliance with requirements
5. Approving utility rates and services
6. Investigating aircraft accidents
7. Allocating radio frequencies
8. Determining compliance with engineering aspects of Federal tax laws

Research. Systematic, critical, intensive investigation directed toward the development of new or fuller scientific knowledge of the subject studied. It may be with or without reference to a specific application. The work involves theoretical, taxonomic, and experimental investigations or simulation of experiments and conditions for several purposes. The following list identifies these activities:

1. Determining the nature, magnitude, and interrelationships of natural and social phenomena and processes.
2. Creating and developing theoretical or experimental means of investigating such phenomena or processes.
3. Developing the principles, criteria, methods, and a body of data of general applicability for use by others. Excluded from this research category is work concerned primarily with the administration and monitoring of research contracts and research grants.

Research contract and grant administration. The administration and monitoring of research contracts and research grants.

Scientific and technical information. Processing and disseminating published and unpublished technical documents and information on work to facilitate their use. The work involves developing and implementing information systems through numerous activities:

1. Providing for the selection, acquisition, compilation, exchange, and storage of scientific and technical information
2. Cataloging, abstracting, and indexing information for retrieval and dissemination
3. Providing reference, literature search, and bibliographic services for information users
4. Interpreting, evaluating, and briefing on the significance and relevance of information
5. Disseminating information through briefings, technical publications, and other communications media
6. Classifying and declassifying technical information where use must be controlled in the national interest

Standards and specifications. The preparation and determination of mandatory and/or voluntary standards including rules, regulations, and codes. Some of the purposes for which these standards are developed include the following:

1. Drafting Government codes and regulations.
2. Assuring the acceptability, quality, and/or standardization of products, materials, and parts as required for design, production, purchasing, logistics, and documentation.The work involves the developing performance criteria, test and inspection methods, and data for the application of the standards to technological products and services.

Teaching and training. The teaching of scientific and technical subjects; the education and training of scientific and technical personnel in-house and through programs consisting of fellowships, traineeships, and training grants; and the development of curriculums, training materials, and aids.

Technical assistance and consulting. The provision of scientific and technical expert assistance, consultation, and advice to other scientific personnel; foreign governments; government agencies at the Federal, state, or lo-

cal level; private industry; organized groups; and individuals. The work involves advising and promoting application of the results of research and specialized program knowledge.

Testing and evaluation. Testing of equipment, materials, devices, components, systems, and methodologies under controlled conditions and the systematic evaluation of test data to determine the degree of compliance of the test item with predetermined criteria and requirements. This work is characterized by the development and application of test plans to be carried out in-house or under contract or grant utilizing one or more of the following kinds of tests: physical measurement techniques; controlled laboratory, shop, and field (demonstration) trials; and simulated environmental techniques. Activities included in this category are as follows:

1. Development testing to determine the suitability of the test item for use in its environment
2. Production and postproduction testing to determine operational readiness
3. Testing in regulatory programs to determine compliance with laws, regulations, and standards
4. Testing in the social sciences using demonstration or experimental and control groups to determine the effectiveness of new methodologies or practices

Other-not elsewhere classified. This category is to be used for the following positions:

1. Those with highly specialized activities that are not covered in any of the other categories
2. Those of such generalized nature that a primary function cannot be identified
3. Trainee positions without functional assignments

Limitations of the Data. The criterion used to classify Federal white-collar employees as scientists and engineers is by examining the occupational definitions of Federal occupational groups and series and determining whether those descriptions meet NSF's criteria. General job series rather than individual job descriptions were examined and categorized; so employees within these series or groups are not necessarily working as scientists and engineers or on S&E work. On the other hand, there are some occupations that have not been classified as S&E occupations. For example, patent examiners have not been included in S&E occupations, even though some of the employees within this occupation are trained as scientists and particularly engineers. (These employees were included in the statistical table on Federal personnel who held their highest degree in S&E but who were employed in non-S&E work.)

The information presented in this report is obtained from OPM's CPDF. The CPDF is updated on a quarterly basis by agency submissions. The agencies collect their data from individual notifications of (SF-50-B) and requests for personnel action (SF-52-B). The forms are usually updated by personnel clerks and are subject to misclassification and miscoding. This is particularly true for three of the data elements, primary work activity (functional classification), highest degree field, and highest degree level. Personnel clerks update primary work activity data and unless they refer to position descriptions or contacts with individual employees (or the employee's manager) whose records are being updated, the coding is subject to misclassification. Education data (highest degree field and highest degree level) are collected only on permanent employees at the time of entry into Federal service and are not routinely updated by additional educational experience after the time of hiring.

For further information on data quality, survey methodology, and error analyses on the data provided to NSF, refer to the Federal Civilian Workforce Statistics, Occupations of Federal White-Collar and Blue-Collar Workers, issued biennially by OPM. The OPM website on Federal workforce statistics can be accessed at http://www.opm.gov/Statistics_Information_Instructions/. The NSF website on Federal scientists and engineers can be accessed at http://www.nsf.gov/statistics/pubseri.cfm?TopID=4&SubID=46&SeriID=15.